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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/752,685

01/03/2001

Shane J. Trapp

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11/16/2005

DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP

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Washington, DC 20037

EXAMINER

CHEN, JACK S J

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 11/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

H-13

<b>Office Action Summary</b>	<b>Application No.</b>		<b>Applicant(s)</b>	
	09/752,685		TRAPP, SHANE J.	
	<b>Examiner</b>		<b>Art Unit</b>	
	Jack Chen		2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1) ☒ Responsive to communication(s) filed on 25 August 2005.

2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4) ☒ Claim(s) 1-13, 15-25, 36-39, 41-46 and 64-70 is/are pending in the application.

4a) Of the above claim(s) 1-13 and 15-25 is/are withdrawn from consideration.

5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.

6) ☒ Claim(s) 36-39, 41-46, 64-70 is/are rejected.

7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.

8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All    b) ☐ Some \*    c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) <input type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413)
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	Paper No(s)/Mail Date. _____
3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)	5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)
Paper No(s)/Mail Date _____	6) <input type="checkbox"/> Other: _____

## DETAILED ACTION

This Office Action responds to communication dated on August 25, 2005.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

- 1. Claims 36-39, 41-46 and 64-70, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al [US 6,140,168] in view of Ding et al [US 5,814,563].**

Tan et al, Figs 1A-1D and cols. 1-6, discloses a method for forming a self-aligned contact opening (124, fig 1D) in an insulative layer (114b) formed over a substrate comprising steps:

providing the substrate (100, fig 1A) comprising adjacent gate stacks being formed thereon, the adjacent gates stacks comprising opposed side wall spacers (108) which have been formed over the adjacent gate stacks [*claims 36, 64*];

forming the insulative layer (114, fig 1B) over the substrate, the adjacent gate stacks and the sidewall spacers which have been formed over the adjacent gate stacks [*claims 36 and 64*];

forming a patterned photoresist mask layer (116, fig 1B) over said insulative layer [*claim 36*];

contacting and etching the insulative layer through an aperture (120, fig 1C-1D) in the patterned photoresist mask layer using a plasma etchant mixture comprising fluorocarbon

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(CHF<sub>3</sub> and CF<sub>4</sub>, col. 3 lines 42-55) [*claims 36 and 66*] so as to form the self-aligned contact opening (124, fig 1D) without an etch stop [*claims 42 and 64*] in the insulative layer located between the adjacent gate stacks and the opposed side wall spacers aligning the self-aligned contact opening to the substrate [*claim 43*], wherein said sidewall spacers are not etched and defines at least in part of said self-aligned contact opening (fig 1D) [*claim 64*];

removing the patterned photoresist mask layer after said contacting and etching [*claim 46*].

Tan et al does not teach: 1) using the plasma etchant mixture essentially consisting of ammonia and said fluorocarbon of a ratio flow rate of the fluorocarbon to ammonia of 2:1 to 40:1 with the flow rate of said ammonia of at least about 2 sccm to form the self-aligned contact opening at a temperature of about -50 to 80°C with further forming a protective layer over the opposed side wall spacers of the adjacent gate stacks; and 2) depositing a conductive plug inside said self-aligned contact such that said conductive plug is separated from said side opposed side wall spacers by said protective layer.

Regarding to 1), Ding et al, figs 1-7 and col 1-14, discloses a method of forming an opening in an insulating layer (20, fig 1d) formed over a substrate (25,32,34, 36, fig 1d) in a semiconductor device comprising etching said insulative layer with an etchant composition consisting essentially of ammonia (NH<sub>3</sub>) and at least one of fluorocarbon (CHF<sub>3</sub> and CF<sub>4</sub>) so as to form said opening wherein flow rate ratio of said at least one fluorocarbon to said ammonia is from about 4:1 to about 10:1 and said flow rate of said ammonia is at least about 2 sccm (col 11-12); said etching includes plasma etching, is performed through a patterned photoresist mask without forming an etch stop, and is performed at a temperature range of about -50 to about

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80°C (see examples). *Regarding the flow rate of ammonia (2 sccm to about 6 sccm), see fig. 4 (Ding et al.), which is within the scope of the instant invention, also see col. 8, lines 1-3 and col. 10, lines 25-40.* Ding et al discloses the etching is performed within a range temperature of about 0-50°C (e.g. 50°C, col 6 lines 51-67). Ding et al discloses the etching is performed at an operating pressure of about 40-50 mTorr (e.g. 50 mTorr, col 5 lines 45-65). Ding et al discloses the etching is performed at the flow rate of CF<sub>4</sub> of about 15-20 sccm (e.g. 18 sccm, col 10 lines 31-33). Ding et al discloses the etching is performed at the flow rate of CHF<sub>3</sub> of about 35-45 sccm (e.g. 40 sccm, col 10 lines 24-26).

Ding et al disclosed using ammonia in addition to fluorocarbon with the flow rate ratio of the fluorocarbon to ammonia of 2:1 to 40:1 and the flow rate of ammonia of at least about 2 sccm for plasma etching the insulative layer at a temperature of about -50 to 80°C would provide a better etch process with a high etch rate and an improved etch selectivity (see col 5-12). Ding et al also teaches using the plasma etchant mixture consisting essentially fluorocarbon and ammonia would form an opening with a protective layer being formed on sidewall of the opening (fig 1b or 1d). Therefore, it would have been obvious for those skilled in the art to modify the process of Tan et al by using the plasma etchant mixture essentially consisting of ammonia and said fluorocarbon with the flow rate ratio and temperature as being claimed, per taught by Ding et al, to etch the self-aligned contact with a better etch rate and improved etch selectivity without an etch stop. In addition, those skilled in the art would recognize that combination of the process of Tan et al in view of Ding et al will form a protective layer containing nitrogen over the opposed side wall spacers in the self-aligned contact opening.

Regarding to 2), depositing the conductive plug inside the self-aligned contact opening is known in the art for forming electrical connection in a semiconductor device. In addition, Tan et al teaches forming a self-aligned contact opening is for forming electrical connection between source/drain region and metal layer [see col 2 lines 15-23]. It would have been obvious for those skilled in the art to modify the process of Tan et al in view of Ding et al by depositing the conductive plug inside the self-aligned contact opening wherein the conductive plug separated from the sidewall spacers by the protective layer since the usage of the plasma etchant mixture consisting essentially of ammonia ( $\text{NH}_3$ ) and at least one of fluorocarbon to provide electrical connection between source/drain region to certain location of the semiconductor device to operate the device.

Tan et al (col 3 lines 42-50) further teaches using the fluorocarbons essentially consisting of  $\text{CF}_4$  and  $\text{CHF}_3$  for etching the insulative layer. Ding et al teaches  $\text{C}_2\text{H}_2\text{F}_2$  can be added to the fluorocarbon mixture for etching the insulative layer. Therefore, it would have been obvious for those skill in the art to use the fluorocarbon mixture comprising  $\text{CF}_4$ ,  $\text{CHF}_3$ , and  $\text{CH}_2\text{F}_2$  to etch the insulative layer in the process of Tan et al in view of Ding et al. In addition, using the fluorocarbons comprising  $\text{CF}_4$ ,  $\text{CHF}_3$  and  $\text{CH}_2\text{F}_2$  has been known in the art for etching the insulative layer. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.).

With respect to claims 36, 39, 41, 44-45, 64-70, claimed ranges of temperature, flow rates, flow rate ratios in the etching step and thickness, absent evidence of disclosure of criticality for the range giving unexpected results are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious. See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

### ***Response to Arguments***

Applicant's arguments filed 8/25/05 have been fully considered but they are not persuasive.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the

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teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, using the etching chemistry as taught by Ding et al. would provide a better etching selectivities [i.e., improve etching rate (col. 5, lines 51-53) thus preventing an etch stop (col. 6 and fig. 1d)] and provide self-aligned contact hole.

With respect to Applicant's argument on pages 4-5, regarding Tan and Ding are not properly combinable. This argument is not persuasive because both Tan and Ding uses fluorocarbons for etching the **insulative laver** for forming contact opening. Ding sees advantage of using ammonia in addition to fluorocarbon in etching the **insulative laver** (the same as Applicant's invention) to improve etching rate (col. 5 lines 51-53) thus preventing an etch stop (col. 6 and fig. 1d). Therefore, it is combinable to modify the teaching of Ding to the process of Tan to improve the process of etching the insulative layer for forming the contact opening, particularly the self-aligned contact opening. The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).



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With respect to the thickness of the protective layer, it is noted that the specification does not disclose anything critical regarding this particular thickness ranges; therefore, this particular range is considered as routine optimization.

Regarding the consisting essentially of language used to narrow the etching chemistry, MPEP 2111.03 states,

"The transitional phrase "consisting essentially of" limits the scope of a claim to the specified materials or steps **"and those that do not materially affect the basic and novel characteristic(s)" of the claimed invention.** In re Herz, 537 F.2d 549, 551-52, 190 USPQ 461, 463 (CCPA 1976) (emphasis in original) (Prior art hydraulic fluid required a dispersant which appellants argued was excluded from claims limited to a functional fluid "consisting essentially of" certain components. In finding the claims did not exclude the prior art dispersant, the court noted that appellants' specification indicated the claimed composition can contain any well-known additive such as a dispersant, and there was no evidence that the presence of a dispersant would materially affect the basic and novel characteristic of the claimed invention. The prior art composition had the same basic and novel characteristic (increased oxidation resistance) as well as additional enhanced detergent and dispersant characteristics.). "A consisting essentially of" claim occupies a middle ground between closed claims that are written in a consisting of format and fully open claims that are drafted in a comprising format." PPG Industries v. Guardian Industries, 156 F.3d 1351, 1354, 48 USPQ2d 1351, 1353-54 (Fed. Cir. 1998). See also Atlas Powder v. E.I. duPont de Nemours & Co., 750 F.2d 1569, 224 USPQ 409 (Fed. Cir. 1984); In re Janakirama-Rao, 317 F.2d 951, 137 USPQ 893 (CCPA 1963); Water Technologies Corp. vs. Calco, Ltd., 850 F.2d 660, 7 USPQ2d 1097 (Fed. Cir. 1988). For the purposes of searching for and applying prior art under 35 U.S.C. 102 and 103, absent a clear indication in the specification or claims of what the basic and novel characteristics actually are, "consisting essentially of" will be construed as equivalent to "comprising." See, e.g., PPG, 156 F.3d at 1355, 48 USPQ2d at 1355 ("PPG could have defined the scope of the phrase consisting essentially of" for purposes of its patent by making clear in its specification what it regarded as constituting a material change in the basic and novel characteristics of the invention."). See also > AK Steel Corp. v. Sollac, 344 F.3d 1234, 1240-41, 68 USPQ2d 1280, 1283-84 (Fed. Cir. 2003) (Applicant's statement in the specification that "silicon contents in the coating metal should not exceed about 0.5% by weight" along with a discussion of the deleterious effects of silicon provided basis to conclude that silicon in excess of 0.5% by weight would materially alter the basic and novel properties of the invention. Thus, "consisting essentially of" as recited in the preamble was interpreted to permit no more than 0.5% by weight of silicon in the aluminum coating.);< In re Janakirama-Rao, 317 F.2d 951, 954, 137 USPQ 893, 895-96 (CCPA 1963). If an applicant contends that additional steps or materials in the prior art are excluded by the

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recitation of "consisting essentially of," **applicant has the burden of showing that the introduction of additional steps or components would materially change the characteristics of applicant's invention.** In re De Lajarte, 337 F.2d 870, 143 USPQ 256 (CCPA 1964). See also Ex parte Hoffman, 12 USPQ2d 1061, 1063-64 (Bd. Pat. App. & Inter. 1989) ("Although consisting essentially of" is typically used and defined in the context of compositions of matter, we find nothing intrinsically wrong with the use of such language as a modifier of method steps. . . [rendering] the claim open only for the inclusion of steps which do not materially affect the basic and novel characteristics of the claimed method. To determine the steps included versus excluded the claim must be read in light of the specification. . . . [I]t is an applicant's burden to establish that a step practiced in a prior art method is excluded from his claims by consisting essentially of language.".) (Emphasis added.)

In this case, Applicant's specification indicated that the claimed composition (essentially consisting of ammonia and at least one or more fluorocarbon) can contain any well known additive such as oxygen, carbon or inert element components (see Applicant's specification on page 10, lines 10-13). Furthermore, Applicant has provided no proof/evidence that the presence of addition of oxygen, carbon or inert element components would materially affect the basic and novel characteristics of the claimed etchant composition of ammonia and at least one fluorocarbon, the prior art etchant composition of Ding of ammonia and at least one of fluorocarbon has the same basic and novel characteristics of the Applicant's etchant composition as well as additional of carbon, oxygen and inert element components.

### ***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after

the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack Chen whose telephone number is (571)272-1689. The examiner can normally be reached on Monday-Friday (9:00am-6:30pm) alternate Monday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead can be reached on (571)272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Jack Chen  
Primary Examiner  
Art Unit 2813

November 14, 2005